Learning from the economics of networks to enhance poverty alleviation in African cotton zones

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Abstract

Cotton sectors in Sub-Saharan Africa (SSA) were run by monopolistic para-statal organisms for a long time. They embarked upon a restructuring/liberalisation process as of the mid-1980s but the outcomes were mitigated at best. As these sectors resemble service distribution networks (telecommunication, power, etc.) in terms of historical monopolies and deregulation, cotton development in SSA could be reviewed and their current restructuring appraised according to economics of networks models.

This paper stresses that cotton sectors in SSA could be considered as service networks. They have a 3-layer morphology and comply with the five recognition criteria as suggested by Curien (2000). Stylised facts regarding network dynamics closely fit former cotton sector development patterns in most SSA countries. Cotton development did not occur without the related networks reaching a critical size that public intervention helped to attain through a time-demanding process.

In areas where cotton production is not very developed, it would not be worthwhile to attempt to restructure existing cotton networks as they are of insufficient size. Where cotton production is well developed, such deregulation could be considered but not through a vertical disintegration procedure. Splitting an existing nationwide monopoly into a limited number of local monopolies is a way of preserving vertical integration and of facilitating geographical regulation which should be more efficient and comprehensive than regulating only through purchase price fixing.

Keywords : economics of networks, cotton, deregulation

Introduction

It is recognised that cotton production generally has positive socio-economic impacts in many cotton producing countries and enhances poverty alleviation (Fortucci, 2002). By the end of 1980s, although cotton production was managed through national monopolies in African Francophone Countries[1] (AFC), it was considered as a "success story" (Hartmann, 1988; Mcphail and Polti, 1988). Since the mid-1990s, cotton sectors of these countries have been involved in a restructuring process, justified by certain neo-classically oriented analyses (Pursell and Diop, 1998), but the economic outcomes have been questionable (Goreux and Macrae, 2002). There is a serious challenge to properly monitoring this process so that poverty alleviation could be pursued in cotton zones.

This paper recommends tapping some outcomes of the Economics of networks along with the deregulation of networks like telecommunications, power distribution, etc., which have also been run by historical monopolies. We think that these outcomes could help to understand the dynamics of African cotton sectors and provide keys to their restructuring.

The first part demonstrates the relevance of considering Sub-Saharan African (SSA) cotton sectors as service networks. The second part provides a critical analysis of the restructuring of cotton sectors according to their dynamics and lessons learned from deregulation experience in service distribution sectors. We conclude on some inputs for readjusting the restructuring of African cotton sectors.

Relevance of considering cotton sectors as service networks

Curien (2000) suggests identifying networks by their 3-layer morphology and five recognition criteria. He considers that each network consists of a lower layer which corresponds to infrastructures. The higher layer represents final services. The middle layer pertains to command & control services, called also "infostructure" whose function is to optimise infrastructure use to provide the final services. This 3-layer morphology is insufficient, and therefore five recognition criteria are recommended, including: a) club effects, b) production synergies, c) crossed subsidies between services and/or between types of clients, d) border conflicts between services in a monopolistic and competitive setting, e) and finally strong public regulation.

A brief review would be helpful before proceeding to identify this morphology and these criteria with respect to SSA cotton sectors.

Brief review of SSA cotton sectors

Growing cotton plants generates seedcotton at harvest. Seedcotton must be processed at ginneries to obtain cotton fibre which is separated from seeds. There is no international market for seedcotton but only for cotton fibre, so ginneries are essential facilities.

[1] Mainly Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Guinea, Mali, Senegal, Chad, Togo which now account for less than 5% of the world production and close to 15% of world exports, ranking only second after USA.

Cotton is produced in nearly all SSA countries where its organisation was dominated, until the mid-1980s, by parastatal agencies which benefitted from monopolies for buying seedcotton from farmers, processing in ginneries and trading/exporting the cotton fibre. Conversely, these agencies were in charge of providing seeds, chemicals and disseminating technical messages to farmers and were obligated to purchase all of the farmers' production. They ran ginneries throughout their operational areas, and had their own fleet of trucks to haul seedcotton from villages to ginneries. They monitored on-field technical staff, according to a pyramidal organisation, in charge of disseminating technical messages to farmers and to flow up the information to help organise seedcotton trading and ginning. In many countries, in particular in AFC, inputs were provided on a credit basis, with reimbursement through seedcotton trading.

In AFC, two dramatic changes should be mentioned. First, since the mid-1980s, seedcotton trading has been transferred to village organisations; it was a service externalisation that generated income for villages. Secondly, activities conducted by the public cotton companies became highly diversified, including technical support for alternative crops, intermediation in well digging or drilling operations, in addition to specific backstopping to benefit rural women. Both of these developments have benefitted from strong funding support through international aid agencies since the late 1970s (Fok, 1993), while some of them are now questioning the rationale behind this diversification.

The three layers in cotton networks

For convenience, we refer to the 1960s period in identifying the morphology of cotton networks even though this morphology has evolved slightly. Hence, the lower layer of infrastructures encompasses ginneries, energy generating units, fleets of trucks and garages for their maintenance. Saw gins were imported from USA with minimal capacities of several thousands of tons of seedcotton, which clearly induced some economies of scale.

The higher layer pertains to services offered to farmers-clients of cotton networks. Basically, these services involved seedcotton trading and seed provision for the following production campaign. Just providing these two basic services would not be sufficient to develop cotton networks as noted in Tanzania and Nigeria (Lele, Van de Walle, et al., 1989). AFC also provided input on a credit basis and disseminated technical messages along with assistance for ox-drawn agriculture and new inputs (fertilizers and pesticides). They also diversified assistance provided in many other areas as already mentioned.

The middle layer consists of two complementary elements. It was first a network of technical staff assigned on-field to disseminate information downstream and upstream. This pertains to the "infostructure" feature. The other generally overlooked element refers to organisation, implementation and monitoring of various tasks scheduled within a pyramidal structure to determine farmers' input needs, to analyse the campaign outlook in view of estimating production levels and organising seedcotton trade (e.g. amount of campaign credit). This element refers to the "operating system" feature by analogy with computer technology or simply "organisation", in the common language, derived mainly from years of experience.

Compliance with recognition criteria

"Club effects" of cotton networks

The functioning of service networks is known to induce positive externalities for clients (Economides, 1996). There are various ways in dealing with these externalities. Some authors have mainly emphasized externalities on the demand side (Curien and Dupuy, 1996), which they call "club effects", while making a distinction between direct or indirect ones. Others have concentrated more on the supply side (Creti and Perrot, 1997), with a decrease in the average cost of production resulting from economies of scale. For simplicity, we will deal with benefits farmers gain through cotton network development, irrespective of their origins.

Generally, there are plenty of "club effects" concerning cotton production. The increase in the number of cotton growers induced an increase in the number of markets. In AFC, most cotton growers can market their output in their villages. Where the seedcotton trade has been transferred to villages, the monetary income that these villages obtain as compensation enabled them to invest in social or economic facilities (infirmaries, schools, warehouses, etc.). The more they produced, the more they could invest and the more these initiatives caught the attention of external funding agencies to help them launch new activities. Cotton sectors are also known to have links with the rare large credible markets for chemical inputs in SSA, thus enabling them to negotiate better conditions for acquiring these inputs (prices, credit, compliance to quality requirements, etc.), advantages they can subsequently transfer to cotton growers. Where ox-drawn agriculture is well developed, a network of village blacksmiths have also emerged which provides services beyond repairing or manufacturing agricultural tools (e.g. cereal grinding services). Maintenance and extension of the rural road and track network is closely linked to cotton development, with positive externalities that help link farmers to the market economy.

Production synergies linked to the "infostructure"

It is common to associate these synergies with the lower infrastructure layer (Curien and Dupuy, 1996). Concerning cotton networks, we think that synergies mainly result from the middle layer of the "infostructure". It was this "infostructure" that enabled diversification of the activities mentioned above. This diversification concerned areas of production and commercialisation, empowerment of farmers by transferring more competences to them, sustainable management of

natural resources, etc.

All of these synergies were achieved thanks to international funding agencies which considered that it would be more effective to launch new activities with limited fixed cost (i.e. no need to hire new specialized staff), while cotton companies found it beneficial to dilute their "infostructure" costs.

Crossed subsidies with cotton networks

This phenomenon particularly applied to seedcotton trade and input provision. In Côte d'Ivoire, until the mid-1980s, inputs were provided free with subsequent costs partly deducted through pricing mechanisms. In many other AFC, inputs were provided at lower than real prices in the same spirit. This phenomenon also occurs between various cotton growers, through the application of a nationwide seedcotton price irrespective of where they are located. This trend is also noted with respect to input provision, either between input types (between insecticides and fertilizers) or within the same input type (a single price for differentiated insecticides).

Border conflicts and regulation

Since the 1980s, AFC cotton sectors have been affected by the controversial conflict between services under monopolistic or competitive provisions. This led to recommendations to privatise the service. In most countries, transportation has been more or less transferred to the private sector. In areas where cotton production is very well developed (Mali, Benin), we noted that recommendations have been put forward to privatise some activities handled so far by the "infostructure", in favour of firms composed of young graduates.

Of course, cotton sectors have long been submitted to strong public regulation with respect to fixing seedcotton purchase prices, with the obligation to purchase all cotton produced nationwide, at a fixed price. This regulation could also concern input selling prices. This regulation was fulfilled either by the government alone, or in association with cotton companies and farmers' institutions within the framework of specific contracts.

The issue of cotton network membership costs

Contrary to common service networks, the nature of cotton network membership and concomitant costs are unclear and non-transparent. This membership fee is paid through the seedcotton trade, implicitly determined with the purchase price.

For this reason, observers who recommend liberalisation of AFC cotton sectors refer to the price paid per kilogram of seedcotton produced when assessing operational equitability. This approach is quite debatable from the perspective of economics of networks. It would be better to make assessments according to the overall income that farmers get from cotton production which integrates yield and acreage devoted to cotton growing, both elements are influenced by the "club effect" or service provision that they actually benefit from. It is even possible that farmers or AFC have a broader concept when dealing with positive food security and other socio-economic impacts, while promoting the continuation of cotton production (Dioum, 2002).

The membership fee to cotton networks is not clearly assessed, i.e. farmers' perceptions are mainly subjective and could vary with time. The cost could be perceived as high when farmers note lower "club effects" resulting from their network membership. This seems to occur in many AFC countries. Input acquisition seems more costly than before, owing to economic liberalisation with subsequent suppression/reduction of input subsidies. Since the world market has steadily decreased since 1997, purchase prices have been constrained, so inputs have become relatively expensive. Although factors are external to cotton networks, the level of the implicit membership fee is questioned. This is only specific to the regulation issue.

Analysis of cotton sector dynamics and deregulation

The economics of networks facilitate assessment of their dynamics and highlight the extent of impact on their economic viability. We will first review the main outcomes before looking at the dynamics of cotton sectors in SSA, and finally assess the deregulation experience to help appraise the current process with respect to cotton sectors.

Noam model on network dynamics

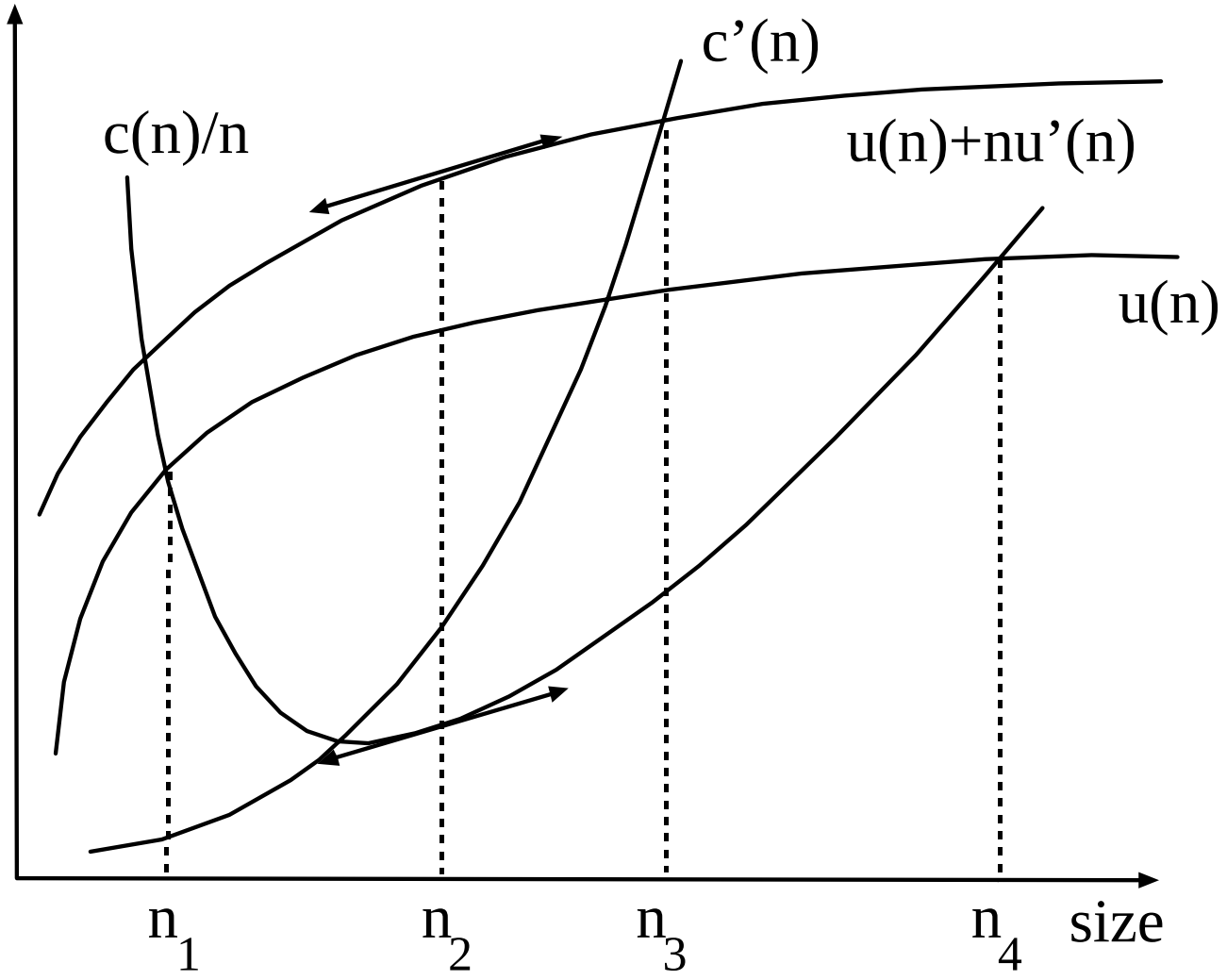
Several models have been developed to assess network dynamics, while taking into account economies of scale that lead to average cost reductions. We will limit ourselves to the Noam model (Noam, 1991).

The Noam model (Fig. 1) considers a utility function of u(n) for each member of the network, an increasing function of the size n but at a decreasing rate (u"(n) <0). The total cost for operating the network is c(n). The unit cost is then c(n)/n which first decreases (as a consequence of the reduction in the fixed unit cost) then augments (as a consequence of the increasing variable unit cost). It is assumed that the network operates at budgetary equilibrium with the price equalising unit cost. Based on this assumption, at the inception of the network, the price is high as compared to the first members' utility and the network is not economically viable until it reaches n_1, which is the critical size. These two curves meet again for a size n_4, which corresponds to the saturation size. Here arises the issue of determining the optimal size between n_1 and n_4 .

Noam distinguishes two modalities in optimising the size. One is to favour the individual benefit of each individual member or the function u(n) - c(n)/n. This leads to the size n_2, which corresponds to the private optimum size. Another is to optimise the benefit to the whole network, or the function n u(n) - c(n), which leads to the collective optimum n_3, where the marginal cost in operating the network is equal to the marginal utility of the last member to join (Figure 1).

This models helps to identify four phases in the development of a given network. An initial phase, prior to reaching the critical size, when the network cannot develop without subsidies. A self-sustained growth phase, from the critical size to n_2 during which the network members can and must contribute to development. An "entitlement growth" or "directed growth" phase from n_2 to n_3 or even n_4 when the government has the rationale to provide support, so collective benefit is optimised and the saturation size could be reached. A phase of growth through external subsidy when universal service provision is considered.

Figure 1. Model showing the four sizes of the service network dynamics



Reviewing the dynamics of cotton sectors in SSA

No possibility of cotton networks at high membership cost

This observation derives directly from models used for assessing networks. Since the membership cost is the purchase price of seedcotton, cotton networks are not sustainable if this price is too low. This was experienced a number of times in many SSA countries during the colonial time when stakeholders were motivated mainly by high short-term return (Henry, 1925; Hesling, 1931; Rabault, 1944).

This risk is still quite relevant. The fact that farmers protest against low prices highlights the danger that networks could disappear. The boycott in sowing cotton in Mali during the 2000/01 campaign was partly motivated by such protests (Sinaba, 2000a; b). Production dropped by 50% at a time when the world price was not very low and this accounts for part of the major financial troubles the Malian cotton sector is still having (Lejeal, 2002) and which remains a serious threat to the survival of this sector. The price level being paid to farmers is related to the international price, which is seriously distorted by support policies in some countries (Valderrama Beccera, 2000). Continuation of this international distortion by developed countries represents a danger of killing cotton sectors in SSA, thus accentuating poverty.

No sustainable cotton network without reaching a critical size

This observation is in line with the previous comments. Since it takes some time to reach the critical size, some cotton companies give up because they have not reached the critical size and do not think they could achieve it. In Mozambique, we observed this phenomenon with the cotton company SAMO, which gave up because it found that the zone it was allocated was too small.

Not efficient to split monopolies of insufficient size

Even though monopoly restructuring may be considered, this should not be undertaken for any size of existing monopoly. Splitting an existing monopoly of insufficient size will result in one that is below the critical size. Some observers are actually advocating the resizing of zones allocated to existing cotton companies in Mozambique, while their networks are obviously still below the critical size. Implementing this recommendation would be detrimental to the cotton sector in this country.

Critical size cannot be achieved without public support

The history of cotton production development in AFC highlights that its growth was low from the end of WWII up to the 1960s. In spite of some public support from the French government which helped ensure an attractive price to farmers, their adhesion was limited until there was massive intervention, beginning in the late 1960s, combining French, European and multilateral aid (especially from the World Bank), which enabled them to use inputs at low cost and low financial risk. This so-called "success story" was mainly in reference to the external support that the economics of networks fully justify *a posteriori.* It is quite amazing that representatives of the World Bank are nowadays imposing deregulation rules that may destroy what this institution helped to achieve.

For countries which try to promote their cotton production, economics of networks show that it is vain to expect a quick outcome, especially without public intervention, as observed in Ghana since 1985 and in Mozambique until recently.

Public support must last longer

Economics of networks concerning industry or service areas does not provide information about how long it takes to achieve the critical size, and it is implicitly assumed that the effect could be achieved quite quickly, as noted with respect to the French telephone network (Curien and Dupuy, 1996). This is not the case for cotton sectors, where external support lasted for decades, in particular in Mali (Fok, 1993), but also in most of AFC.

Several factors could help to explain this slow process. Cotton production was launched in colonial times, which left a negative image in farmers' minds and even with the government of the new states, which first just tolerated its production before actually appropriating it 15 years later. Cotton production also involves business from smallholders who have very limited resources and face considerable adverse risk—so they showed some reluctance in committing themselves to cotton growing, which demands some input use and could lead to some food security risk. It took time for them to overcome this risk perception. Finally, the most significant "club effects" are related to the transfer of seedcotton trade to farmers, along with management of input credit, whose implementation initially required illiterate farmers to be properly trained, and enough people had to be trained to avoid poor governance due to an over-limited core, while ensuring transparency and democracy (Bingen, Carney, et al., 1997; Bingen, 1996). This process required time.

Promotion of cotton production is time consuming especially in the current international context of more frequently changing and higher world prices (Fok, 1997), partly as a consequence of distortion induced by developed countries.

Diversification of services by cotton networks is economically justified

Production synergies help networks to decrease average costs and gain viability by increasing their size. This was felt to some degree by the cotton sector staff when realising the limitations of focusing exclusively on cotton production (Cissé, 1986), so they welcomed the activity diversification that occurred.

This diversification has likely gone too far. Nevertheless, it is unfortunate that the economic rationale behind it is totally overlooked in favour of activities solely focused on cotton (Badiane et al., 2002; Mali, 2001). We doubt that this will lead to positive outcomes.

Fatality of going beyond the saturation size?

We reported on the extent of diversification within cotton companies in AFC. Some observers believe that it was excessive and this was the rationale that led to recommendations of centring activities solely on cotton. We will not discuss this controversial position but believe that there was actually a risk that cotton companies would go beyond what they could reasonably manage, since diversification calls for further diversification in African cotton areas.

The basis of this assumption is that cotton companies are facing a highly diversified rural setting. Launching new modalities by providing technical assistance to villages which were organised in associations did not allow abandonment of former modalities for villages without associations. Securing rice production by improving water collection gave rise to the need to assist people in managing growing techniques, not only during the rainy season, but also off-season when

farmers found that it was profitable to devote themselves to off-season productions.

Most cotton companies did not know how to deal with sequencing additional demands, nor did the external funding agencies who supported the activity diversification trend. Minds have now changed. Cotton networks are no longer regarded as efficient in helping to provide services to rural societies. Alternative operators (private firms set up by young graduates, farmers' organisations, etc.) are being favoured, who come with new ideologies, but people do not seem to assess how efficient they are.

Lessons learned from network deregulation for cotton sectors

Although we have already discussed some current options for restructuring cotton sectors through network dynamics, we will supplement this with lessons derived directly from experience in deregulating large service networks.

Natural "institutionalized" monopolies?

Deregulation opponents used to insist on the natural aspect of existing historical monopolies. This argument is debated by partisans of deregulation who recall that the natural monopoly feature emerged after the related companies were entitled to monopoly rights. As a consequence, it is argued that what was established by institutional processes could be renewed through a new institutional process.

The development of cotton sectors confirms this argument since monopolies were institutionalised after decades of promotion through competition. However, they were institutionalised after people observed that the "free market" approach was unsuccessful. This was the rationale behind the creation of "cotton zones" in the former Belgian Congo—a formula that spread to many other European colonies (Fok, 1997). What Ghana decided in adopting "cotton zones" in 2000 is just a remake of the Belgian story we are discussing, while in Zimbabwe successful privatisation was found to lead to oligopolies (Larsen, 2002).

The institutional feature of the cotton companies enables their restructuring, but this deregulation alone does not ensure better performance. This is a matter of new regulation.

Considering an overlooked regulation strategy?

Three regulation modes are commonly contemplated: regulation by tariff fixing, by contesting the market of the existing monopoly, and geographical regulation of local monopolies. The first one is the most commonly applied with generally the same limitations in terms of proper appraisal of production costs. Fewer people endorse the theory of contestable markets (Baumol, Panzar, et al., 1982), whose application led to inefficient and disappointing results with respect to telephone network regulation (Curien and Dupuy, 1996). Geographical regulation has not often been applied.

All cotton sectors in SSA have relied on regulation of purchase prices for seedcotton and they still do. All existing mechanisms are based on the identification of production costs which always prompt debate and disputes between stakeholders. A proposal has been put forward to sidestep these disputes by disconnecting the pricing mechanism from the difficulty to assess production costs (Goreux and Macrae, 2002; Lemaître et al., 2001). This proposal is based on determining seedcotton prices according to a collectively agreed ratio established on the basis of a world price index issued daily by the Cotton Outlook Company. The only difficulty is to get people to agree upon a reasonable ratio. Another constraint is that this ratio is not independent of current world prices, so how should the ratio evolve when world price variations remain an issue?

Tariff regulation is not very satisfactory when the cotton network has various positive effects to benefit its members, as mentioned above. Basically, a regulation should be based upon a multi-criteria process, with the purchase price being only one of the relevant criteria. In this regard, indirect regulation or geographic regulation seems to offer better prospects. Since several countries have already favoured the option of cotton zones or local monopolies (Côte d'Ivoire, Ghana, Mozambique, and Mali soon), there is now an opportunity to apply this regulation. In practice, companies endowed with local monopoly rights must commit themselves to providing information needed to assess services they actually provide to their network members.

Deregulation and preserving "club effects"

Deregulation experiences based upon vertical disintegration have led to disappointing outcomes, so restructuring by separating the three layers of a network morphology is no longer recommended (Curien and Dupuy, 1996). In the case of cotton sectors in SSA, this means that integration must be preserved by associating technical service provision, input provision, and ginning. This is currently far from being the case. In Benin, private ginners are discharged from all activities other than ginning. In Côte d'Ivoire, in spite of a clear zoning distribution, nothing is clear with respect to the extent of each cotton company's sphere of activity. In Mali, a long-term decision has been taken in favour of local monopolies which are to be established, but vertical disintegration is being adopted (technical advice to be addressed by public agencies, input provision by farmers' syndicates, etc.).

Preserving universal service in a deregulating process

In the area of network services, it is frequently raised the concern of making sure that some stakeholders are not excluded from network services. In the case of cotton, there is a risk of exclusion of farmers who are located too far from ginneries because cotton companies want to control their transportation costs. Since farmers will likely not accept to be excluded, part of them could decide to move close to ginneries, thus possibly leading to land conflicts, accentuated forest clearing and social turmoil with local populations. These phenomena are currently occurring in Mozambique.

Wherever there is a risk of excluding farmers from growing cotton, public intervention could be justified in terms of poverty alleviation and natural resource management. The current restructuring of AFC's cotton sectors does not seem to currently integrate this dimension.

Conclusion

AFC cotton sectors have embarked upon a restructuring process motivated by neo-classical analysis strategies implemented by the World Bank. Other studies highlighted the relevance of analysing from an imperfect competition viewpoint (Fraval, 1999), such as economics of networks, a research corpus that focuses on analysing the deregulation of large service networks run historically via monopolies.

This paper stresses that it is relevant to consider cotton sectors in AFC, including SSA, as service networks. They have 3-layer morphology and comply with the five recognition criteria suggested by Curien (2000). We believe that the middle "infostructure" layer is of particular importance, but unfortunately it seems to be overlooked in the current restructuring process.

Stylised facts regarding network dynamics closely fit cotton sector development patterns in most of AFC. Such development could not take place unless the network reached a critical size, which public intervention helped to attain. This intervention lasted a long time due to socio-economic factors associated with SSA smallholders, as well as psychological factors linked with production that was promoted in colonial times.

In areas where cotton production is not very developed, it would not be recommended to restructure existing cotton networks because of their insufficient size. Where cotton production is well developed, e.g. in several AFC, such deregulation could be considered but not through a vertical disintegration procedure. Splitting an existing nationwide monopoly into a limited number of local monopolies could preserve vertical integration and also enable the adoption of geographical regulation, which should be more efficient and comprehensive than regulating only through purchase price fixing. Unfortunately, there is no clear position in favour of vertical integration although some AFC have engaged geographical monopoly processes.

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